

VISIT...

LANZAROTE
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Walking into the future
with feeling legs

SENSARS



NEUROPROSTHETICS

www.sensars.com

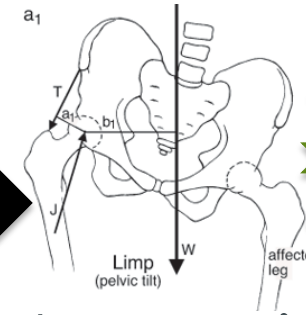
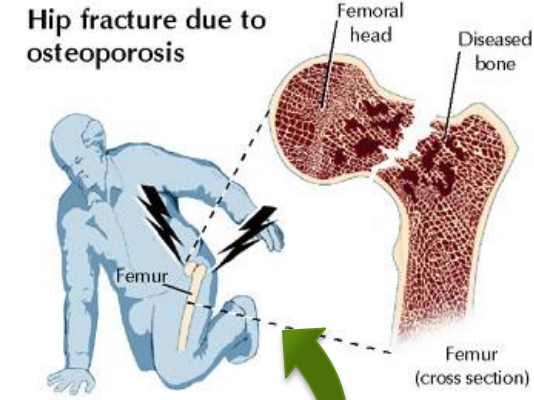
The problem: lack of sensory feedback from prosthesis

Osteoporosis

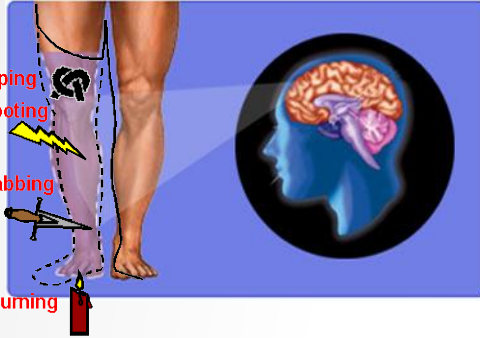


Arthritis

Back pain



Asymmetric walking and balance



Severe phantom limb pain

High metabolic cost
Fatigue



Feeling prosthesis as foreign body results in its abandonment



Market Size (only EU and USA)

WE WOULD LIKE TO LEARN ABOUT ASIA!

LOWER LIMB
AMPUTEES
3.9 million

LOWER LIMB
AMPUTATION/YEAR
380 thousands

USERS
of lower limb
prosthesis
1.5 million

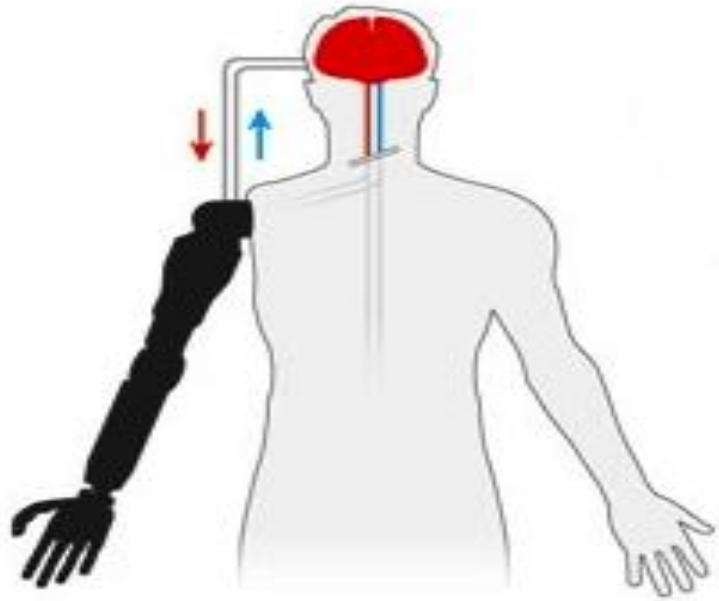
OTTOBOCK
722 million €
sales of
upper and lower limb
protheses in
2013

OSSUR
509 million \$
sales of
lower limb
protheses in
2013

Lower limb prosthesis users are 38% of the whole amputees.

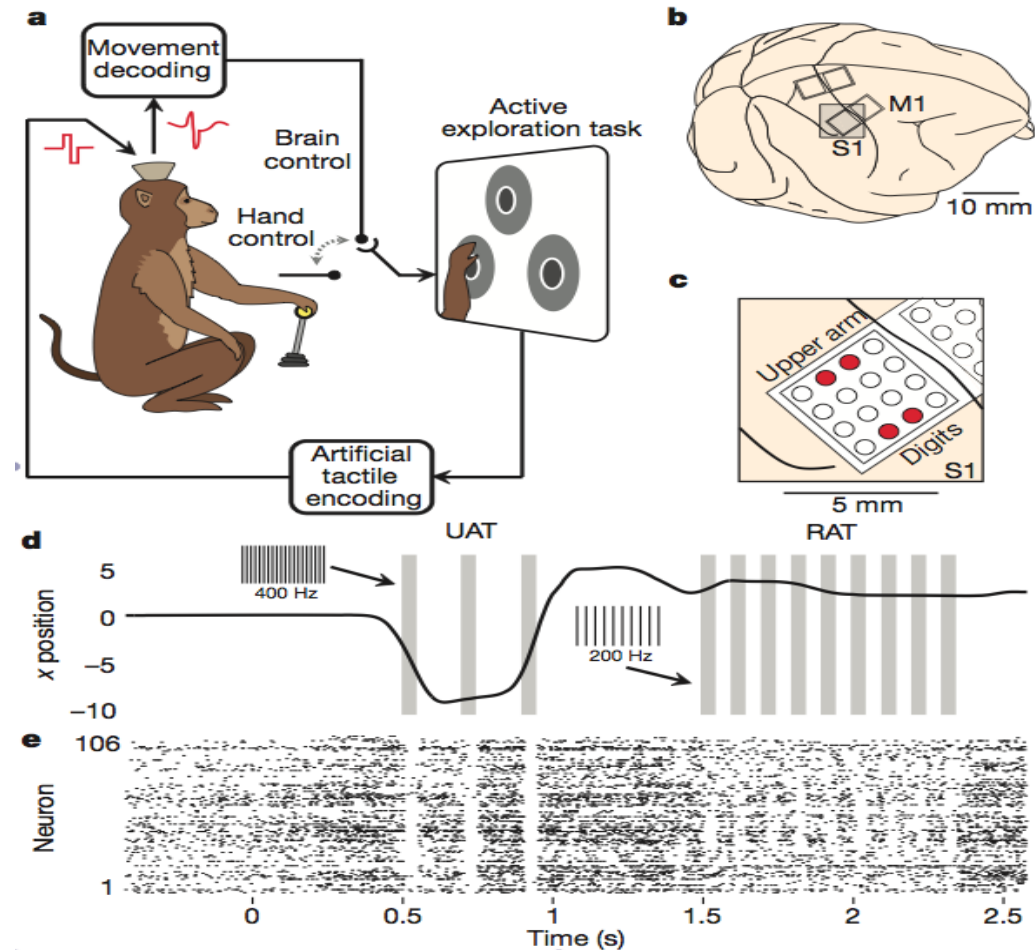
Leaders in lower limb prostheses market have revenues for more than 1B per year

Closing the loop at the Brain level

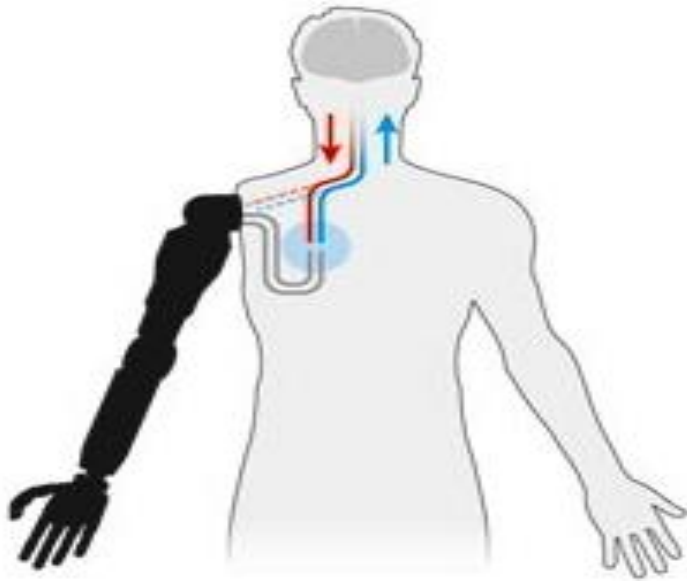


Stimulate the brain

Sensory signals are routed around a severed spinal cord and into the brain, where they produce sensations by direct stimulation of the cortex.

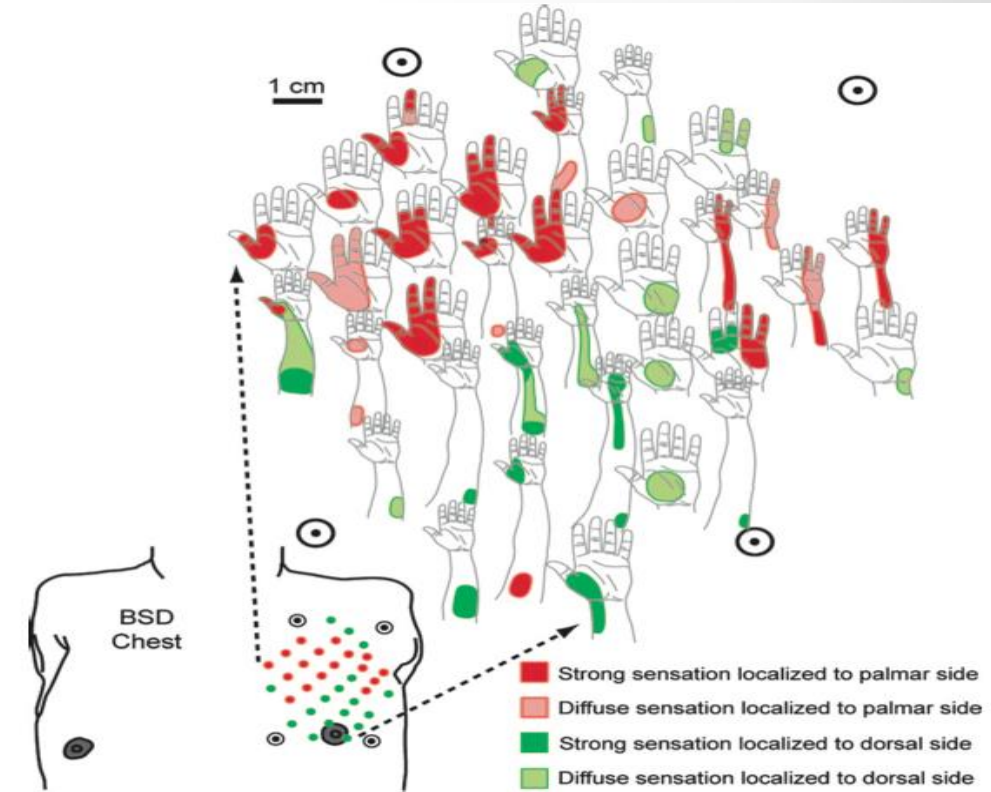
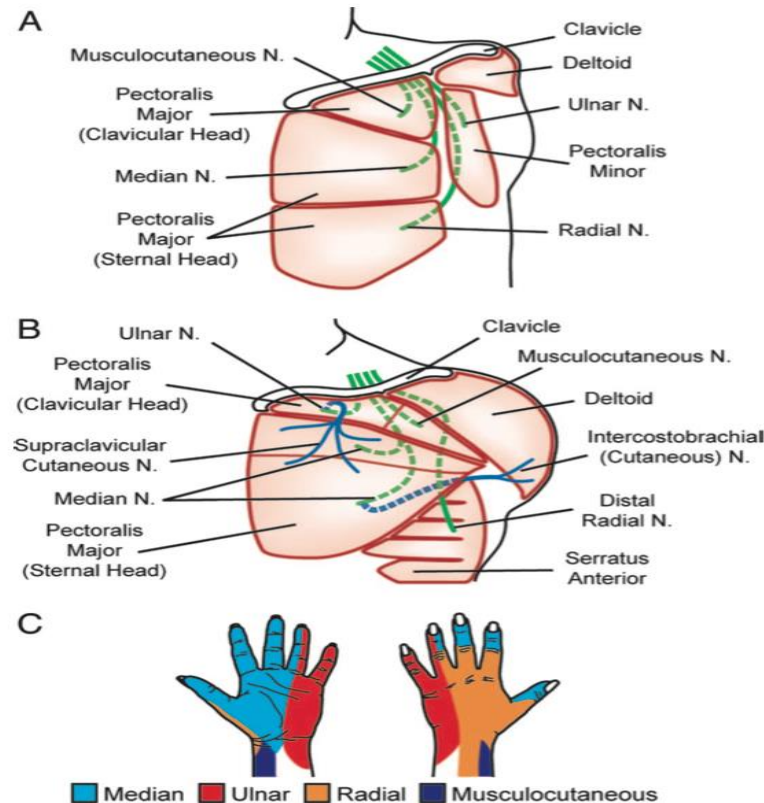


Closing the loop by re-routing nerves

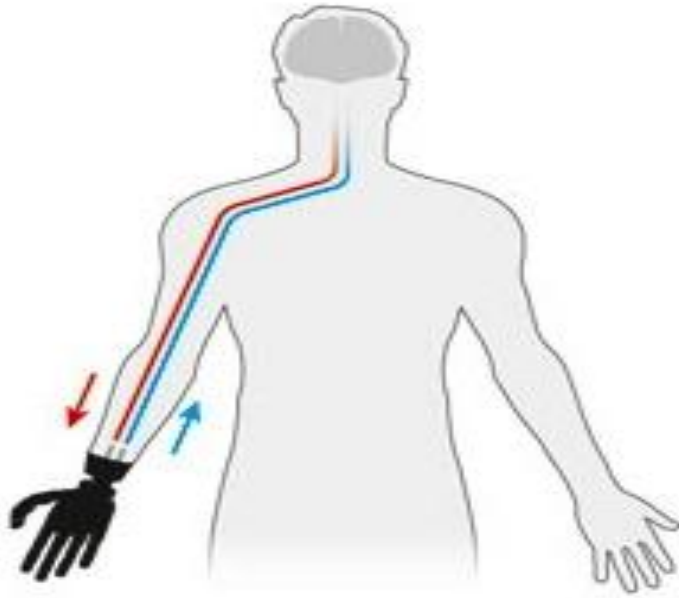


Move the nerves

Re-routed nerves grow new endings into muscle and skin, where external devices translate signals going to and from the prosthesis.

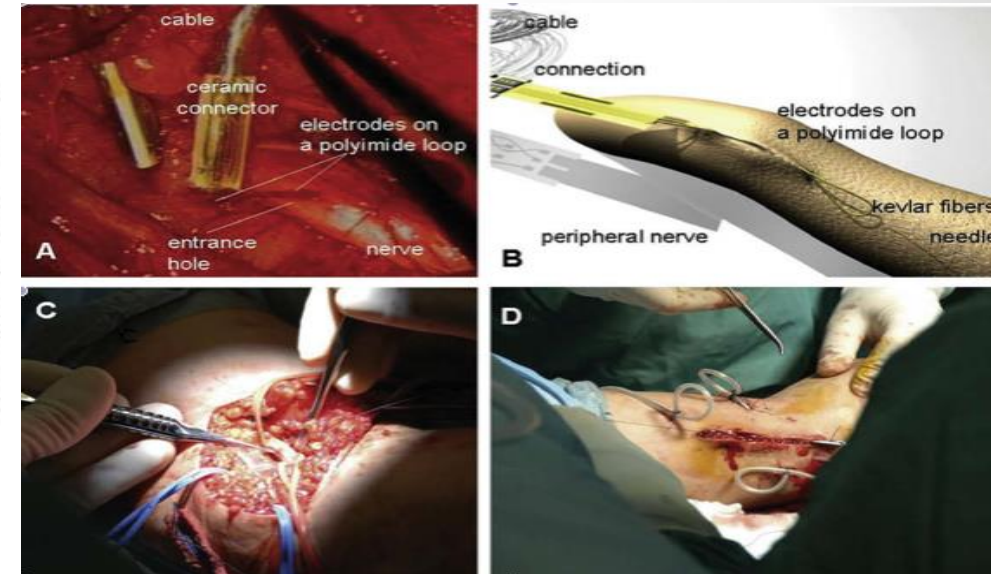
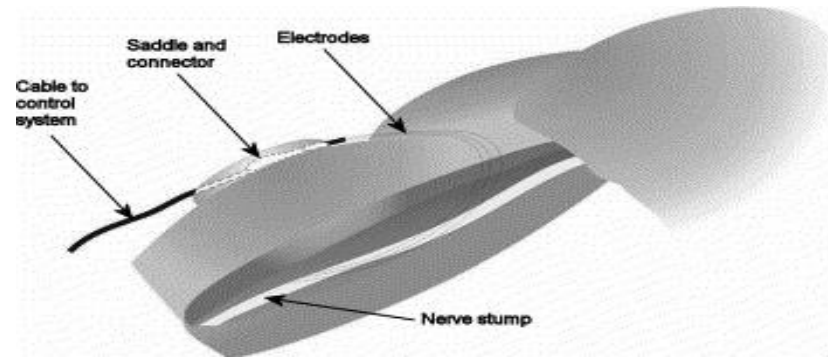


Closing the loop- direct peripheral nervous system (PNS) stimulation



Use the remaining nerves

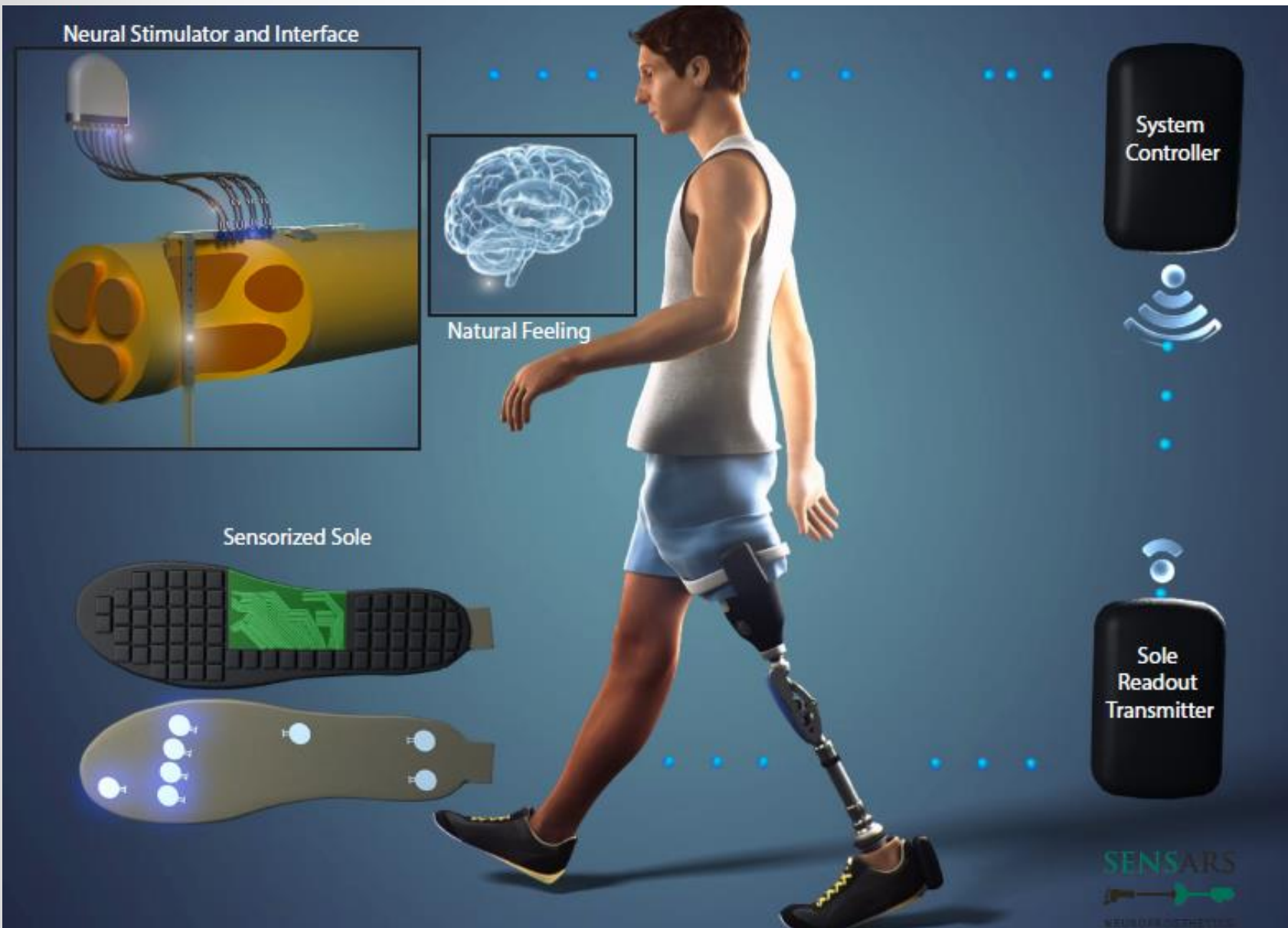
Electrical leads from the prosthetic's sensors stimulate nerves in the person's stump that once served the real limb.



Dhillon G. S., Horch W. & al.
J Neurophysiol. 2005

Rossini P. M., Micera S. & al.
Clin. Neurophysiol. 2010

Our solution: SENSY



A **unique device worldwide** which allows amputees, unlike current prostheses, to feel again naturally from missing limbs.

It is **add-on** to any commercial prosthesis.

SENSY comprises an implantable stimulator and **intraneural electrodes for sensory nerve stimulation** commanded by a smart controller connected to a **sensorized sole**.

Meet the team behind the idea



FRANCESCO MARIA PETRINI

PhD

Since 5 years Francesco develops smart and innovative strategies to create the link between the human peripheral nervous system and technology. He has received his PhD in neuroprosthetics and neural interfaces at Campus Bio-Medico (Rome), and also visited for more than two years the most important technological schools of Europe, École polytechnique fédérale de Lausanne (EPFL, Switzerland) and Imperial College of London, receiving business and management competencies.



STANIŠA RASPOPOVIĆ

PhD

Staniša has over 8 years of experience in neuroprosthetic field, especially in the algorithms development, modeling, electronics, animal and clinical experimentation. He graduated at University of Pisa (Italy) with honours in Electrical and Biomedical Engineering (MSc) and got the PhD at Scuola Superiore Sant'Anna (SSSA, Italy) in Neuroengineering and Robotics.



SILVESTRO MICERA

Professor

Silvestro is the Professor of Neural Engineering at the Scuola Superiore Sant'Anna (SSSA, Italy) and Associate Professor of Neural Engineering at École polytechnique fédérale de Lausanne (EPFL) where he holds the Bertarelli Foundation Chair in Translational NeuroEngineering. He is the world pioneer in the areas of development of neuroprosthetic and robotic solutions to restore sensory-motor functions in disabled people.

Among top problems for hand prostheses-feedback

- To feel the hard curvature of a baseball or the soft cylinder that is a plastic glass-these sensations we often take for **granted**.
- **Nerve-injured persons** often do not have any functionality over the injured limb resulting in paralyzed and/or unused extremity.
- Dexterous manipulation is result of the complex relationship between motor commands, executed movements, and **sensory feedback** during hand activities.
- Restoring the sensory pathway should improve the **controllability**, but also restore the ability to **perceive the environment**.
- Without sensory feedback the prosthesis is perceived as **foreign body**.
 - **Among the top reasons for abandonment of prostheses.**

SENSY is not anymore a dream: Meet Dennis

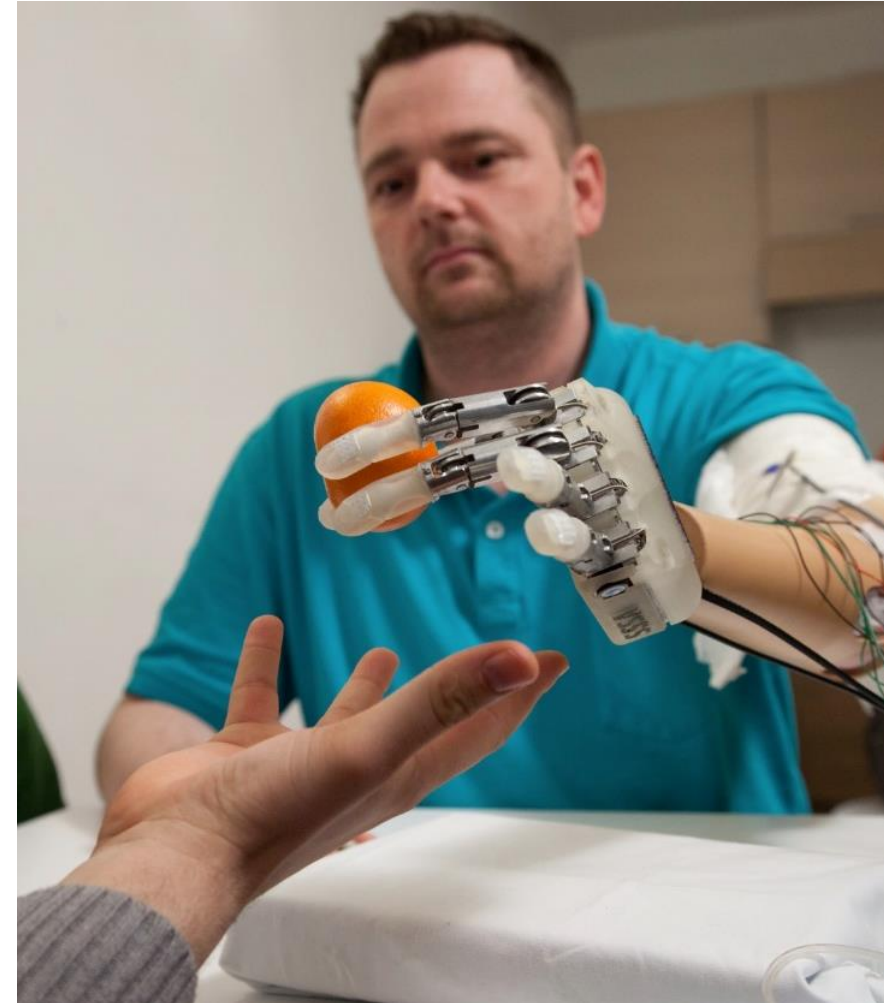
SENSY **working principle** has been tested with an upper limb amputee.

He was able to feel **repeatable and natural touch sensations over different areas of missing hand**.

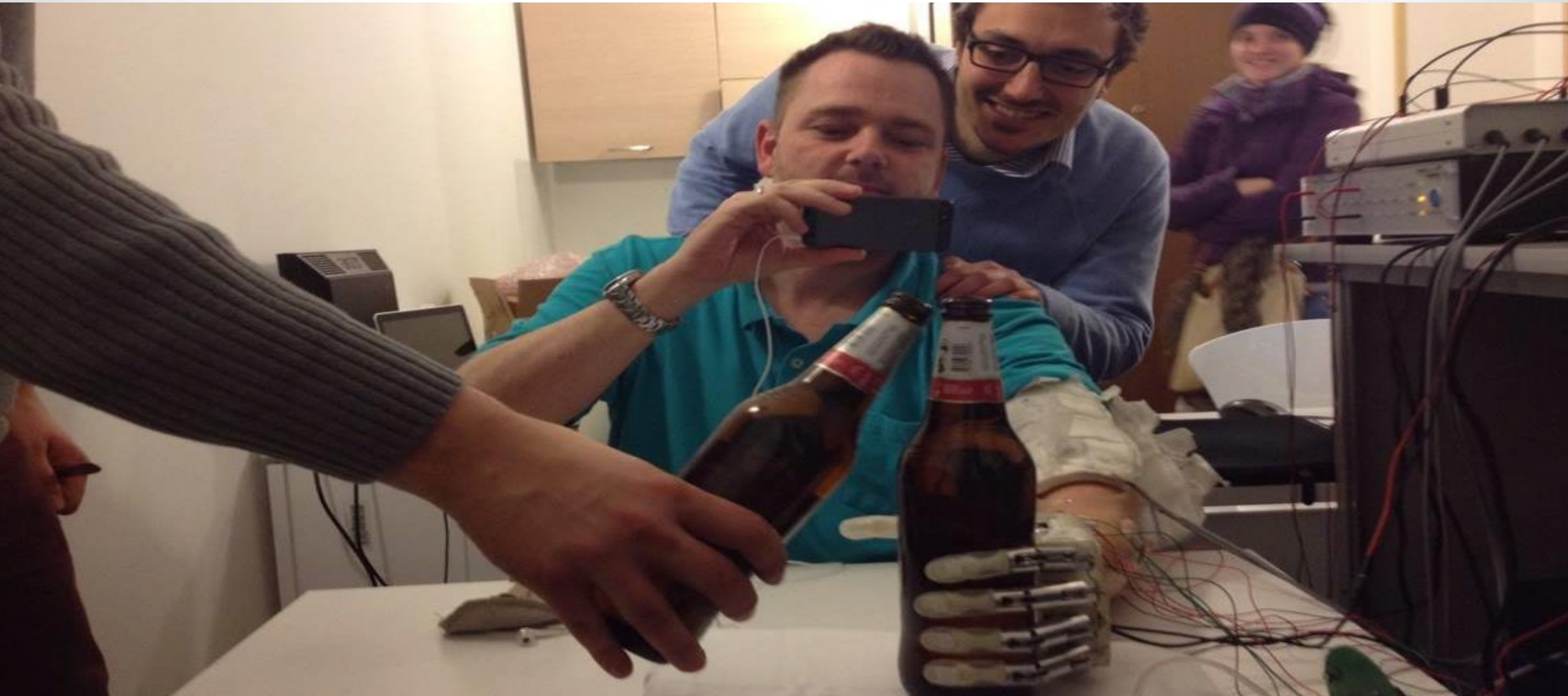
He managed to:

- Control the force applied with the prosthesis
- Distinguish the stiffness of objects
- Distinguish the shape of objects

Moreover, he reported **phantom pain diminishing**.



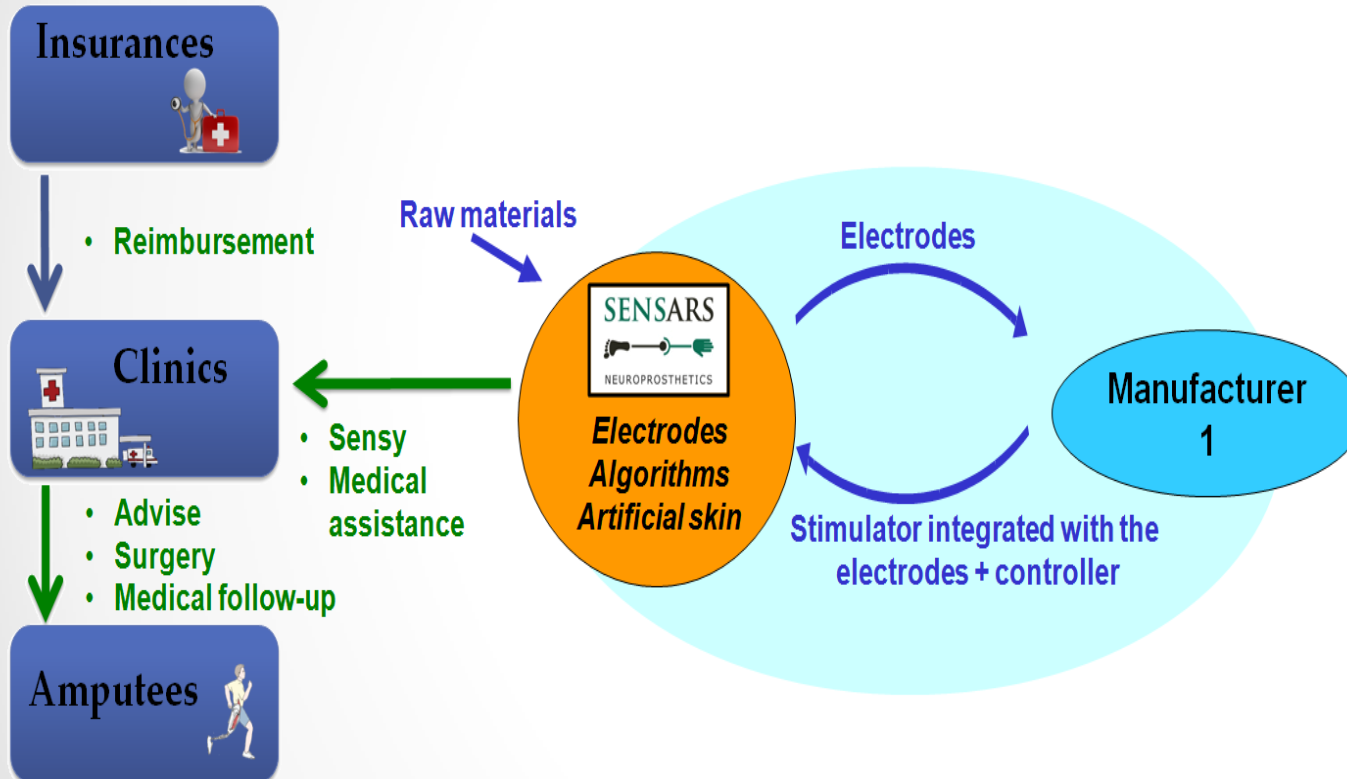
Future: understanding if the beer is cold enough



IP protection

- International Patent Application n° PCT/IB2014/067143 filed on December 19, 2014 claiming priority of the International Patent Application "provisional" n° PCT/IB2013/061286 filed on December 23, 2013 and priority of the Swiss Patent Application n° CH 01340/14 filed on September 4, 2014
- The patent belongs to EPFL which has an agreement for a contract of exclusive licence with SensArs Neuroprosthetics

Business Model



SENSY is sold to clinics

SensArs specialists assist the clinics during the outpatient surgery and stimulation parameters settings

Private or public insurances reimburse SENSY to the clinics

Benefit for the society and Reimbursement

- ✓ SENSY, preventing the occurrence of osteoporosis, arthritis and back pain and reducing the power consumption produces a **clinical benefit for lower limb amputees** and justifies national health systems reimbursement.
- ✓ Indeed, it has been calculated that the **cost of the adoption of SENSY** is lower than the one for treating osteoporosis, arthritis and back pain.
- ✓ The **amount of reimbursement** for CPT code 64999 is variable, however, an estimation can be obtained from CPT code 64568 (neurostimulator electrode array and pulse generator) recently granted to vagus nerve stimulation device

Field of applications

- A. Restoration of tactile sensation to lower limb amputees:** SENSY, restoring the sensory feedback enables the amputees to walk symmetrically and to avoid the insurgence of osteoarthritis, osteoporosis and back pain, and to reduce the power consumption, preventing falls. Moreover, SENSY heals phantom pain and favors the embodiment of the prosthesis.
- B. Restoration of tactile sensation to upper limb amputees:** SENSY, restoring sensory feedback, enables the amputees to control the force exerted with prosthesis and to recognize shapes and compliances of objects. Moreover, SENSY heals phantom pain and favors the embodiment of the prosthesis.
- C. Neuropathic pain treatment:** it can be treated by producing physiological-like delivery of information to the brain;
- D. Amputation prevention:** people affected by nerve damages face atrophy of the diseased limb, which may lead to amputation. By using SensArs' nerve stimulation system, it can be possible to restore the functionalities of the limb (i.e. reactivating it) and thus allowing prevention of atrophy and the of consequent amputation;
- E. Research:** provision of the sub-systems of SENSY to research institutions;
- F. Behind touch:** SENSY can be used for interfacing the nerves that code sensations different from touch, as hearing and sight. Human nerves, indeed, have similar structure within the body and convey in a comparable way information to the brain.

It is easy to make the world a better place

- A. If you are able to develop implantable neuromodulation medical devices*
- B. If you want to invest into the better future of society*
- C. If you are interested in collaborating with us*



Please contact us at: office@sensars.com